SOLAR NOBLE GASES IN A LOW DENSITY PHASE OF THE H CHONDRITES KALVESTA AND ALH76008: EVIDENCE FOR A PRIMITIVE PLAGIOCLASE CRUST OF THE CHONDRITE PARENT ASTEROID(S)?.

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Introduction: In the framework of the investigation of a possible pre-exposure of a large chondrule in the H6-chondrite ALH76008, we observed solar noble gases in a plagioclase rich mineral separate [1,2]. The presence of solar gases in ordinary chondrites is not uncommon, but their carrier phase is to our knowledge not known. In order to check whether the solar gases in other chondrites are concentrated in the same phase, we prepared mineral separates for the Kalvesta H4 chondrite for which the matrix material yields a $^{20}Ne/^{22}Ne$ ratio of 1.862 (Table) indicating that about half of the Ne is of solar origin.

Experimental procedure: From a bulk sample of Kalvesta we prepared about fifty 2mm thick slices. Most chondrules in these slices were removed with a dental drill. Material from the remaining slices, depleted in chondrules, was crushed in a stainless steel mortar to a grain size of < 340 µm. From this sample metal grains were removed using a hand magnet in an acetone bath. The remaining silicates were further separated into a weakly magnetic fraction and a non-magnetic fraction, again using a hand magnet but without acetone. Finally, the magnetic and the non-magnetic silicates were separated into density fractions < 3.0 gcm^{-3} and > 3.0 gcm^{-3} by sedimentation in aqueous sodium polytungstate ($3\ Na_2WO_4 \cdot 9\ WO_3 \cdot H_2O$).

Results: The results of the noble gas measurements are shown in the table together with the concentrations of the trapped isotopes ^{20}Ne and ^{36}Ar. As for ALH76008 the magnetic < 3.0 gcm^{-3} fraction clearly shows the largest amount of trapped neon and argon. The ratio $^{20}Ne/^{36}Ar$ of this fraction is 3.776 and indicates a solar origin for these trapped gases. A three isotope plot (figure) gives a trapped $^{20}Ne/^{22}Ne$ ratio of 12.3±0.1. This ratio is the same as that for the < 3.0 gcm^{-3} magnetic silicate fraction of ALH76008 and is typical for solar gas rich ordinary chondrites. This value is intermediate between the ratios for solar wind (SW, 13.8) and solar energetic particles (SEP, 11.2) [3] and indicates that solar Ne in this separate is a mixture of SW and SEP.

The mineralogy of the Kalvesta fractions were investigated using a CAMECA SX50 electron microprobe. The following mineral compositions were found: the non-magnetic fractions consist mainly of forsterite and enstatite with minor plagioclase, sulfide, diopside, and very fine-grained matrix. The magnetic < 3.0 gcm^{-3} fraction is mainly composed of fine grained matrix fragments, possibly a mixture of recrystallized glass and angular mineral fragments. The matrix has a composition similar to plagioclase (ca. 65% albite, 35 % anorthite). Enstatite, forsterite, minor quartz/tridymite, plagioclase, and kamacite were also identified. The magnetic > 3.0 gcm^{-3} fraction consists of forsterite, enstatite, matrix grains, and minor contributions of troilite and kamacite.

Discussion: We conclude that the magnetic < 3.0 gcm^{-3} silicate fraction contains a matrix constituent which was exposed to solar gases. It is not clear whether this happened after the accretion of the parent body of Kalvesta (and ALH76008) or in the solar nebula. Wetherill [4] suggested a model (model l) in which solar gases are trapped by grains and small planetesimals at the innermost edge of the solar nebula. Wacker and Marti [5] found argon-rich 'sub-solar' gases in the enstatite meteorite Abee and concluded that an origin based on the model of Wetherill [4] is possible. We can not exclude that also the solar gases in these two chondrites were trapped by matrix material at the innermost edge of the solar nebula.

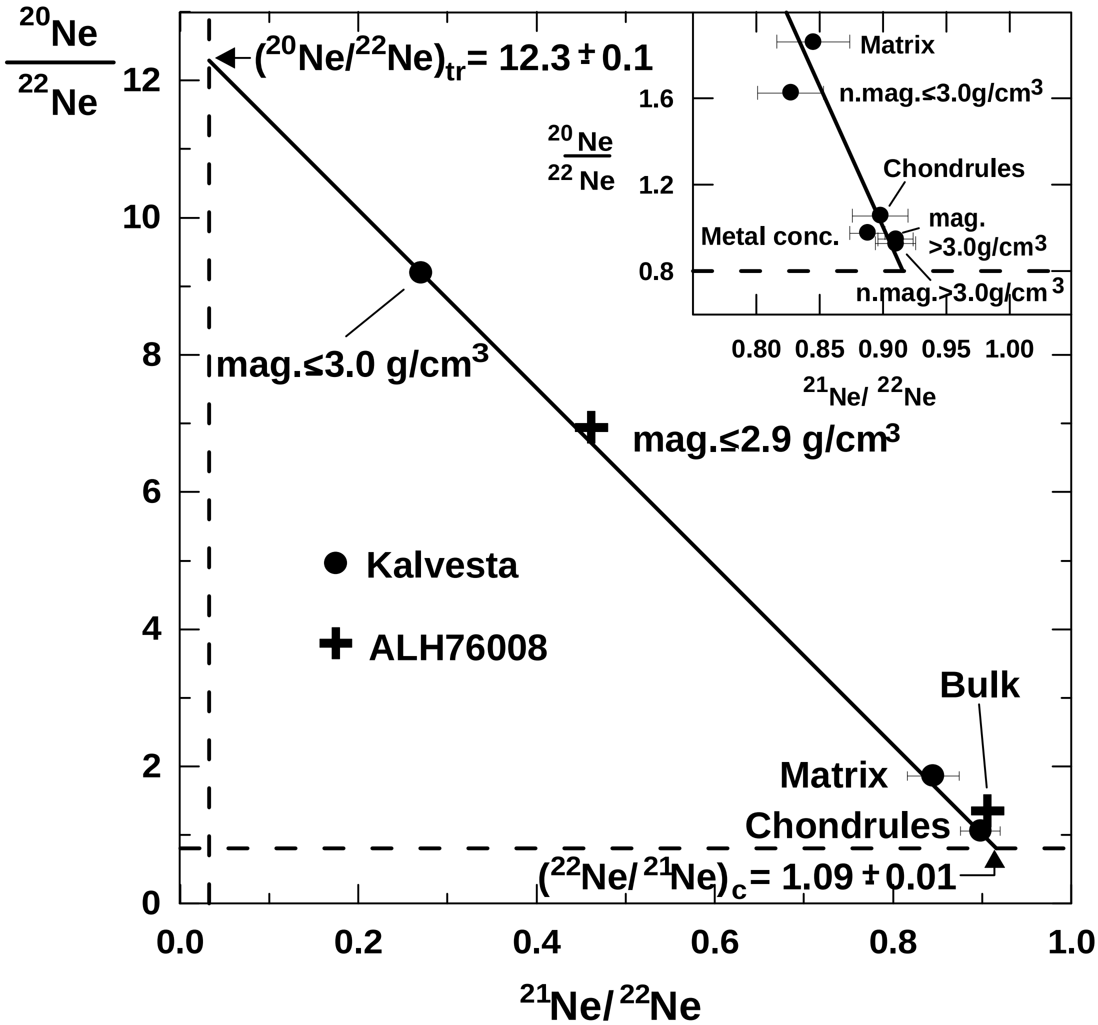
The < 2.9 gcm^{-3} magnetic silicate fraction from ALH76008 contains a high proportion of plagioclase. Also the < 3.0 gcm^{-3} magnetic silicate fraction from Kalvesta mainly consists of fine matrix grains composed of plagioclase. The ancient lunar highland crust consists of anorthosite (plagioclase-rich rock). The chondrite parent asteroid(s) may also have formed an early plagioclase-dominated crust whose fine grained structure was efficient in trapping solar particles. This top layer was later mixed with underlying unirradiated material mainly consisting of olivine and pyroxene (model 2). This model supports the idea that many asteroids are rubble piles which are reassembled from bodies disrupted by impact [6].

Acknowledgement: This work was supported by the Swiss NSF.

References: [1] Polnau E., Eugster O., Thalmann Ch., Weigel A., and Marti K. (1996) *Meteoritics & Planet. Sci., 31 Suppl.,* A109. [2] Polnau E., Eugster O., Krähenbühl U., and Marti K. (1998) *GCA., in press* [3] Benkert J.P., Baur H., Signer P., and Wieler R. *GCA, 98,* 147-162 [4] Wetherill G.W. (1981) *Icarus, 46,* 70-80. [5] Wacker J.F., and Marti K. (1983) *Lunar and Planetary Science Letters, 62,* 147-158. [6] Davis D.R., Weidenshilling S.J., Farinella P., Paolicchi P., and Binzel R.P. i*n Asteroids II (eds. Binzel R.P., Gehrels T., Matthews M.S.),* 805-826

Noble gas concentrations (10^{-8} cm^3STP/g) and isotopic ratios of Kalvesta.

	measured								trapped		
	^{4}He	^{20}Ne	^{40}Ar	$^{4}He/^{3}He$	$^{20}Ne/^{22}Ne$	$^{22}Ne/^{21}Ne$	$^{36}Ar/^{38}Ar$	$^{40}Ar/^{36}Ar$	^{20}Ne	^{36}Ar	$^{20}Ne/^{36}Ar$
matrix	935	0.640	4510	801	1.862	1.183	4.89	2102	0.41	2.10	0.193
chondrules	1523	0.490	6840	945	1.057	1.114	3.80	5425	0.13	1.18	0.122
non.magnetic < 3.0 g/cm^3	1253	0.725	11086	976	1.626	1.209	4.62	4414	0.40	2.47	0.164
non.magnetic > 3.0 g/cm^3	1355	0.450	5956	782	0.929	1.099	4.45	4073	0.07	1.43	0.049
magnetic < 3.0 g/cm^3	3440	13.99	11515	1688	9.200	3.699	4.82	3105	13.66	3.62	3.776
magnetic > 3.0 g/cm^3	1286	0.406	5663	837	0.948	1.099	4.85	3502	0.07	1.60	0.044
metal phase	968	0.341	868	866	0.977	1.127	5.08	2637	0.07	0.33	0.207
typical exp. errors [%]	3	3	4	1-2	1	1	3	3	10	4	12



Neon three isotope plot for the Kalvesta samples and two ALH76008 samples. An inset is shown for the lower right corner.